

ON THE GENUS *PETALURA*, WITH DESCRIPTION
OF A NEW SPECIES.

By R. J. TILLYARD, M.A., F.E.S.

(Plate xxxiii.)

The genus *Petalura* was created by Leach in 1815 to contain a remarkable dragonfly of great size which he received from his friend, W. J. Hooker, from "New Holland" (N.S.W.). The insect was absolutely unlike any other dragonfly known to Leach, but he placed it in the family *Æschnidae*, although he was careful to remark upon the many differences it possessed from all other members of that family. Since then it has remained for a long time classed with the subfamily *Gomphinae*, until only lately Krüger has removed it and constituted a new family, *Petaluridae*, to contain it, placing it between *Gomphinae* and the *Calopterygidae*.

Before we attempt to place the genus arbitrarily in any assigned position, we must recognise the difficulty that always occurs in dealing with aberrant genera. It is this. All naturalists admit the imperfections of a simply linear classification, in which an attempt is made to arrange in a definite line a series of genera or families on which the forces of natural selection have been exerting themselves through countless ages. That it can be done at all shews us indeed that all natural development has proceeded more or less on the same lines; and that if Nature is prodigal in variation, she is nevertheless chary in innovation. But it sometimes happens that a whole race, or a series of races, has been completely wiped out in the past, save, perhaps, for some solitary form, more stable than its congeners. Such a form, or forms, on

whose behalf natural selection has been exercised to so full and favourable extent that it can hold its own, with little further variation, in the changing world around it, has, we may suppose, existed until the present day. To us then it will appear as an aberrancy, a form without near relations, and one whose origin we can scarcely hope to explain, and whose position in a *linear* classification it were almost hopeless to determine.

Petalura is a good example of these aberrant forms. Its great size and remarkable formation will make it one of the Odonatologist's chief treasures and most careful studies. Let us examine carefully then the points which may throw light upon its position in the recognised classification of *Odonata*:—

1. *Head* rather small for the size of the insect, being scarcely as broad as the thorax. In the *Gomphinae* and *Calopterygidae* the head is broader than the thorax, the nearest approach to equality being in the genus *Ictinus* (a genus which I think shows some points of approach to *Petalura*). As regards the eyes, these are slightly smaller and further apart, considering the size of the insect, than in the *Gomphinae*, but larger and closer together than in the *Calopterygidae*.

2. *Thorax* large and powerful. It shows a near approach to the *Gomphinae*. As regards the size of the prothorax, which is fairly well developed, we see again a similarity to the *Calopterygidae*. The legs are strong and thick, but afford no criterion for comparison; the *Odonata* on the whole use them but little, and they show little variation.

3. *Abdomen*: a point of great interest is the presence of rudimentary spurs on the second segment of the male. The *Gomphinae* have well-developed spurs, the *Calopterygidae* have none. In *Petalura* we have the spur about half-formed. As regards the general shape of the abdomen, *Petalura* is widely different from the *Gomphinae* and very similar to many of the genera of the *Calopterygidae* (compare for this purpose *Diphlebia*).

4. Appendages: in these we have the most remarkable divergence of all. The appendages of *Petalura* (male) cannot be brought into line with those of other *Odonata* at all. It resembles the *Libellulidæ* and *Æschninæ* in having only one inferior appendage; both the *Gomphinæ* and *Calopterygidæ* have two. Moreover it would require a stretch of the imagination to see in the breadth of its single appendage an approach to bifurcation, though it is possible that the double inferior appendages of the *Gomphinæ* may have been brought about by that means. As regards the superior appendages, they are beyond all doubt most remarkable, and would almost appear to have been developed for use as a rudder during flight. The insect is able to open and shut them, and when flying holds them fairly vertical, but I have not been able to observe what use is made of them when the insect is about to descend, or when it is hovering in the air. Here again imagination may depict the process of forcipation, as we see it in the *Calopterygidæ*, being brought about by the change, firstly, to a laminate appendage, as in *Petalura*, and, secondly, by the hardening of the upper and stronger curved edge of the lamina, and the gradual loss of the under portion. In this case we might also regard the teeth that occur often on the undersides of forcipate appendages as the relics of the lower portion of the lamina. A careful study of a number of forcipate forms may reveal the truth of this supposition, but at present it cannot be pressed. The appendages of the female are not remarkable, and do not call for comment.

5. Wings: these show no connection whatever with the *Calopterygidæ*, but a considerable resemblance to the *Gomphinæ*. Fore- and hindwings dissimilar. (a) *Pterostigma* of enormous length; narrow as in the *Æschninæ*, and not convex as in the *Gomphinæ*. Here, however, the genus *Ichneumon* is again an exception, as it shows a considerable lengthening and narrowing of the stigma. (b) *Wing-triangles* distinctly dissimilar, that of the forewing being narrower than that of the hindwing, as in the *Libellulidæ*. However, an examination of the simple triangles of

the *Gomphine* should show us that they also are not really *similar* except in an approximate sense. The triangles of *Petalura* appear to me to be closer in formation to those of a majority of the *Corduliine* than to those of any other subfamily. (c) *Anal angle* (δ) and *membranule*: angle very marked, membranule very small, as in the *Gomphine*.

Reviewing the above points, there seems to be no doubt that *Petalura* is a far closer approach to the *Gomphine* than to the *Calopterygidae*. And of the genera comprised in the *Gomphine*, *Ictinus* should be singled out as the nearest approach to *Petalura*, particularly in the shape of the head and thorax, the length of the pterostigma, and the dissimilar triangles crossed by one or more nervules. Apart from these points, the differences between *Petalura* and *Ictinus* are so insuperable that the family *Petaluridae* must stand. It should probably be placed at the end of the division *Anisoptera* which the American authors use to include the *Libellulidae* and *Æschnidae* with their subfamilies. The division *Zygoptera*, of which the *Calopterygidae* are the first family, will follow it in the linear order; but it must be borne in mind that the gap between *Petalura* and these latter is far greater than the gap between *Petalura* and *Ictinus*.

While I was collecting in the Cairns district of North Queensland, during the summer of 1904-5, I was told of the occurrence there at rare intervals of a dragonfly of such enormous proportions that I scarcely credited the story. It was said to come swooping down "like a bird," and local residents went so far as to declare that "its bite would pretty well kill you." When I captured *Anax guttatus* at Atherton I thought this was the species referred to, but when I showed it to a Cairns resident he declared that the one he had spoken of was far bigger than that. I kept on the look-out, and a few days before I left Kuranda I was rewarded by seeing an enormous dragonfly along the banks of the River Barron. I was unable to capture it, but I could see that it was a *Petalura*. A day later a local collector brought me a female of the species, which he had captured in the bush. It was in bad condition, but measured about $6\frac{1}{2}$ inches across the

wings. This year I have received from my friend, Mr. E. Allen, of Cairns, a beautiful male, in fine condition, taken near Herberton. With this material to work upon, I was soon able to determine that this enormous dragonfly, without doubt the largest known, is a new species of *Petalura*, very distinct in many respects from Leach's *P. gigantea*.

In this paper I propose to give a careful definition of both species, a good description of *P. gigantea* being very much needed.

Firstly as to the position and definition of the family *Petaluridae*. The following key will determine it:—

Division *Anisoptera* (fore- and hindwings dissimilar).

- | | | |
|----|---|----------------------------|
| | { Eyes very close together.. .. . | 1. |
| | { Eyes just touching..... .. | <i>Cordulegasterinae</i> . |
| | { Eyes separate..... .. | 2. |
| 1. | { Triangles elongated, similar..... .. | <i>Æschninae</i> . |
| | { Triangles dissimilar..... .. | 3. |
| | { Two inferior appendages in male..... .. | <i>Gomphinae</i> . |
| 2. | { One inferior appendage in male, superior appendage | |
| | { broadly laminate..... .. | <i>Petaluridae</i> . |
| | { Hindwings of male rounded at anal angle..... .. | <i>Libellulinae</i> . |
| 3. | { Hindwings of male angulated (except <i>Hemicordulia</i>) | <i>Cordulinae</i> . |

Genus *PETALURA*.

Insects of great size. Head rather small, eyes separated, ocelli in a triangle. Thorax strong and broad, prothorax fairly well developed. Abdomen rather narrow, elongate subcylindrical. Spurs of segment 2 present in male, but not well formed. Appendages of male: superior broadly laminate, inferior broad, covering the basal portions of the superior beneath. Triangles dissimilar, that of the forewing crossed by two nervules, that of the hindwing by 1-3 nervules (rarely free). Subtriangle of forewings reticulated, of hindwings free. Basilar space free; submedian space crossed by one nervule. Pterostigma exceedingly long and narrow. Anal triangle of hindwing in male very long, narrow, divided into three cells.

1. PETALURA GIGANTEA Leach (Zool. Misc. ii. p.96).

(Plate xxxiii., figs.2, 5-6.)

♂. Total length 87-97 mm.; abdomen 63-73 mm. Forewing 52-58 mm.; hindwing 50-56 mm.

Wings: *Neuration* black, strong, costa pale yellowish outwards, ribbed with black. Triangle of forewings with two cross-nervures, of hindwings with one cross-nervure (rarely free). Hindwings strongly angulated anally. *Pterostigma* very long and narrow, black, 9 mm. in forewing, 10.5 mm. in hindwing. *Membranule* small, pale; forewing 1.5 mm.; hindwing thicker, 2 mm. *Nodal Indicator* circ. 19 circ. 10 | Head: *Occiput* thick, downy, black, slightly 14-16 9-10 | raised in middle. *Eyes* 2 mm. apart, dark brown, a yellow line behind on the orbital ridge. *Vertex* small, black; the two outer ocelli set on raised tubercles, the middle one slightly in front, smaller, not raised, black; antennæ 3.5 mm., black. *Front* large and broad, slightly indented medially; the base, next the vertex, is covered by the black colour of the vertex, forming a transverse band along the base; rest of front pale yellow finely granulated with black dots. *Clypeus* very dark brown shading to black; an obtusely pointed lamina on each side, projecting downwards to labrum; *labrum* pale yellow, a fine black point entering medially from above; lower parts of mouth dull dirty yellowish, mouth edged with black or dark brown. Thorax: *Prothorax* blackish, with a touch of yellow on the collar behind; covered with downy greyish hairs. *Meso-* and *metathorax* large, strongly built, downy, colour chocolate-brown above, dorsal and interalar ridges touched with black, the former elevated near the middle into an obtuse spine; on either side of the dorsal ridge, and touching it, is a broad band of dull orange-brown, the outer margin being slightly curved; some greyish hairs in front next the prothorax and also on the notum near the wing-joints. Sides glaucous brown with a distinct straight lateral band of dirty yellowish-grey which is continued across the notum; rest of notum black. Lower parts of sides brownish, with grey hairs; near the abdomen is a second

sublateral stripe, parallel to the former and of the same colour, but not so large or distinct. Underside covered with grey hairs. *Legs* strong and thick, with very small stiff hairs or spines; black, except coxæ, which are pale brownish. *Abdomen*: fairly thick at base, then tapering slightly to 4, 4 to end cylindrical. Colour: 1, blackish, grey hairs on sides, a touch of yellow on each side near 2; 2, spurs distinct, but not very large and projecting very little; dark brown, a dorsal stripe of dull orange yellow and on each side a broad patch of yellow; a touch of yellow on spurs: 3-4, basal half dark brown, anal half almost black, dorsal stripe as in 2, but narrowing; on either side an irregular stripe of orange-yellow, broken by the transverse central carina which is pale brown, and by the sutures, which are black and rather broad; these stripes broaden out anally, forming narrow transverse bands of orange-yellow, the two portions just meeting on the dorsum: 5-7, nearly black above, the dorsal stripe still present, but very narrow, the lateral stripes very irregular, the anal band exceedingly narrow, the two portions *not* meeting on the dorsum, transverse central carina black; 8, black above, an irregular patch of orange-yellow on each side, broadening anally into a fine transverse line, the two portions just meeting on the dorsum in a small orange-yellow spot; 9, orange-yellow, an irregular transverse narrow basal black band, projecting slightly on each side into a small round black spot; 10, same size as 9, black, bordered anally by a transverse orange-yellow band. Underside black, strongly powdered with grey. Viewed broadly, the abdomen may be said to possess a narrow dorsal stripe, tapering, from 2 to 7, and a very irregular lateral stripe on each side, broken by the carinæ and sutures. *Appendages* most remarkable. *Superior* large and broad, laminate, curved, somewhat rudder-shaped, length about 6 mm., bases strong and thick, separated; about midway on the inner margin is a projecting portion forming a right angle; colour, inner basal half pale orange-brown, semi-transparent, outer and upper half very dark brown; edges and bases black. *Inferior* about 2.5 mm. long by 4.3 mm. wide at tips; acutely pointed on

each side; somewhat convex, and hiding the bases of the superior appendages (viewed from below); colour orange-brown, semi-transparent, base and tips blackish (Pl.xxxiii., figs.5-6).

♀. Total length 82.96 mm., abdomen 58.70 mm.; forewing 56.60 mm., hindwing 54.58 mm.

It differs from the male as follows:—Pterostigma, fore 11.5 mm., hind 12.5 mm.; hindwings rounded anally. Head and thorax as in male. *Abdomen* broader, very regular, cylindrical, *slightly* tapering from 2 to 8. A few grey hairs on 1-2, rest smooth; 3-6 brown above, with anal one-fourth black and a fine black line along the transverse central carina. The dorsal stripe is distinct and regular but narrow; the lateral stripes less irregular than in the male; 8, black, with an anal band of orange-yellow, extending half-way down each side and flanked by a flat triangular yellow portion which appears to have been just cut away from it (due to the interception of the supplementary carina, which is here very close to the suture); 9, very short, basal three-fifths black with a dorsal yellow spot, rest yellow; 10, short and narrow, black, projecting anally beyond appendages in a brownish tubercle. Ovipositor large and thick, upcurved, reaching to end of abdomen and carrying near the tip two minute filaments consisting of a short stumpy base from which emerge a few stiff straight hairs. *Appendages* very short, 1 mm., black, conical, bluntly pointed.

Hab.—New South Wales; rare: Blue Mountains, Moss Vale, Sydney; November-January.

2. PETALURA INGENTISSIMA, n.sp.

(Plate xxxiii., figs.1, 3-4.)

♂. Total length 120 mm.; abdomen 92 mm.; forewing 74 mm., hindwing 71 mm.

Wings: *Neuration* black, costa yellowish outwards ribbed with black. All triangles crossed by two nervures; subtriangles of forewings with 6-7 cellules. Hindwings strongly angulated anally. *Pterostigma* narrow, black, very long, fore 13 mm., hind

14 mm., covering 8 cellules. *Membranule* very small and narrow, dirty flesh-coloured. *Nodal Indicator* ||21 12-14|
 Head: *Eyes* dark brown separated by occipital ||16-17 12-14|
 ridge, 3.5 mm. long, black. *Vertex* small, black; ocelli close together, rather large, brown; antennæ black. *Front* black with a broad transverse yellow band above, slightly narrowed in the median cleft; *clypeus* black; *labrum* yellow bordered with black, the black colour projecting slightly from above into a small central spine; *genæ* yellow; *labium* pale dirty yellowish-grey; mouth edged with dark brown. *Thorax*: *Prothorax* fairly broad, very dark brown, paler on the ridge behind. *Meso-* and *metathorax* rich dark brown, a subtriangular dorsal area of dull yellowish with its base next the prothorax, enclosing the dark brown dorsal ridge, which rises into a sharp spine near its centre. On either side a broad straight lateral band, and a sublateral band very low down, both dirty flesh-colour; the former band crossing the notum. *Legs* large and strong, jet black. *Abdomen* very long, slender, subcylindrical; 1-2 thickened, 3-6 tapering slightly, 7-10 enlarging slightly. Colour black or very dark brown, dorsal surface of 1 and base of 2 with pale grey hairs; 1, a yellow patch on each side; 2, a fine yellow dorsal line, a transverse anal band, enlarging on each side into a large yellow lateral patch; separated from this patch there is also a large basal yellow patch; spurs partially formed, with a deep depression behind them, but with little elevation; colour yellow, brown at the bases: 3, a narrow transverse yellow basal band and a similar anal band, joined on each side by an irregular lateral band of yellow, crossed by the slanting black line of the supplementary carina; 4-7 with narrow transverse basal and anal yellow bands, 4 sometimes showing the beginnings of a lateral band on the sides; 8-9 with narrow transverse anal yellow bands; 10 touched anally with yellow; 10 rather flat above, and both 9 and 10 short and of about equal length. *Appendages* very remarkable. *Superior* broad, laminate, somewhat rudder-shaped, 8.5 mm. long by 7 mm. wide; wide apart at bases, and carrying on the inner margin a portion forming an obtuse-angled projection. Colour very dark

brown, almost black, bases quite black. *Inferior* short, 3 mm., rather broad, terminated on each side by a short spike; convex beneath; black (Pl.xxxiii., figs.3-4).

♀. Total length 125 mm.; abdomen 94 mm.; forewing 78 mm., hindwing 76 mm.

Very similar to the male in coloration, differing as follows:—Hindwings rounded. *Abdomen* broader and more cylindrical than in male. Ovipositor large, blunt, reaching to end of abdomen, upcurved, black, carrying two tiny filaments as in *P. gigantea* female. *Appendages* short, 1.5 mm., pointed, black; separated by the large rounded anal projection of 10.

Hab.—North Queensland; very rare: Cairns, Kuranda, Atherton and Herberton. December-January. The type male was taken at Herberton, the female at Kuranda.

The two species, though closely allied, can be distinguished at once by differences of size and coloration. The following points should be specially noticed:—

The expanse of wing in *P. gigantea* is ♂ about 110 mm.; ♀ about 120 mm.

„ „ *P. ingentissima* ♂ 151 mm.; ♀ 163 mm.

The front of *P. gigantea* has a great deal more yellow on it than that of *P. ingentissima*; this is shown clearly in the plate. The upper thoracic markings are different in shape; *gigantea* having two well defined bands, *ingentissima* a triangular area, formed by two short bands which narrow very rapidly. The subtriangle of the forewings has 3 cellules in *gigantea*, 6-7 in *ingentissima*. The anal angle of the hindwings of the male is slightly more pronounced in *gigantea*. The yellow markings of the abdomen are very different; *gigantea* has the dorsal and lateral bands along nearly the whole of the abdomen; *ingentissima* has but the beginning of them on the first two or three segments. Again *ingentissima* has transverse bands on every segment except 1 and 10; *gigantea* has not. Finally, *gigantea* has the 9th segment bright orange-yellow; *ingentissima* has it nearly black. The appendages on examination will be found to differ remarkably, as may be seen in the plate: As regards the superior appendages, those of *ingentissima* are broader, and less angulated on the inner margin; their colour, too, is black, while those of *gigantea* are semitransparent brown: The inferior appendages are very different both in form and coloration (see figures).

In conclusion, the addition of this wonderful new species to the list of Australian *Odonata* is of great interest, showing us, as

it does, that the *Petalura* of Leach is not the last of its race, but that a greater and even more remarkable species, closely allied to it, still exists to add to our knowledge of this isolated form.

EXPLANATION OF PLATE XXXIII.

Fig.1.—*Petalura ingentissima*, n.sp.; ♂ nat. size.

Fig.2.—*Petalura gigantea* Leach; ♂ nat size.

Figs.3-4—*Petalura ingentissima*, n.sp.; ♂ appendages.

Figs.5-6.—*Petalura gigantea* Leach; ♂ appendages.

(Figs.1-2, photo H. King; figs.3-6, R.J.T. del.).